The ribs of a serpent, which extend nearly throughout its whole length, are very much smaller near the neck and near the tail. At both these parts exuviation is much slower than where the larger ribs have play in the process. This rib action produced an automatic movement of the snake on the floor of its box, and across the folds of its companion, which kept as still as if it were dead. This involuntary movement of the reptile's body was almost imperceptible. All told, it might have been through two feet of linear space. But the exuviated skin was nearly six feet long. This movement seemed much greater than it really was. It was emerging from a tubular case, which was doubling upon itself for a while, the inner or unevolved part shortening as it moved forward with the body; the outer, or evolved part lengthening as it moved backward from the body. The cast-off skin is presented inside out, so that every scale is now seen on its under or concave side, and this is also true of the eye-scales. To all this there is one exception: the last scale of the tail is a hollow pyramidal or four-sided spike. This, for plain reasons, is not everted. When the shedding has reached this scale a sharp shake of the extremity is sufficient, and the uneverted spike is left inside of its everted skin. The entire process of exuviation, allowing five minutes for the part that I did not witness, took thirty-five minutes.

Let me add that in poor health a snake has a hard time in getting off its old coat. I could detail an instance wherein the process took three months. The old skin adhered stubbornly to the new one, and was only removed by friction and by tearing off mere bits at a time. SAMUEL LOCKWOOD

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The "Hexameter," Πᾶσα δόσις ἀγαθή . . .

THERE is an obstacle in the way of regarding this passage (James i. 17) as a hexameter quoted by the Apostle from some poet, as the late lamented Prof. Clerk Maxwell is reported in Mr. Garnett's interesting notice of his life, work, and, not least, his character, to have suggested. The final syllable of δόσις is short, as the accentuation of πρᾶξις and similar verbal nouns proves. *Arsis*, as in "Βέλος ἐχεπευκές," Il. α, 51, can hardly be pleaded. J. J. WALKER

University Hall, W.C., November 17

THE SWEDISH NORTH-EAST PASSAGE EXPEDITION[1]

DURING the wintering of the *Vega* large quantities of the bones of the whale were found on the beach. These at first were supposed to be the remains of whales that had been killed by the natives or by American whalers. On examination it was found that they must be sub-fossil. This was confirmed by the natives, who stated that no whale had driven on land in the memory of man. The remains were found to belong to four or five different species, of which *Balena mysticetus*, or a nearly allied type, was the most common.

Prof. Nordenskjöld investigated the formation of the strata of frozen earth several hundred feet thick which occur in Siberia as in Polar America. Along the coast of Siberia there is a stratum of water resting on the bottom of the sea which is several degrees below the freezing-point, so that a flask of the comparatively fresh surface water, when sunk into this stratum, begins to freeze. Stuxberg observed that the trawl-net often froze fast to the bottom. This was accounted for by the freezing of the fresh water which the net carried down with it from the surface. Nordenskjöld thinks that the mud carried down by the rivers into the sea as it sinks to the bottom carries with it fresh water adhering to the minute particles, and that this fresh water, like that carried down by the net, freezes at the bottom, forming thus a frozen stratum, which increases year by year until it reaches an enormous thickness. He is of opinion that a portion of the earthy layers of Siberia was formed in this way, although, he adds, he by no means considers this the only way in which such formations arose.

Along the whole coast, from the White Sea to Behring's

Continued from p. 40.

Straits, no glacier was seen. During autumn the Siberian coast is nearly free of ice and snow. There are no mountains covered all the year round with snow, although some of them rise to a height of more than 2,000 feet. With one exception there were no rocks along the coast precipitous enough to be suitable breeding-places for sea-fowl, but a large number of these birds were seen during spring flying farther to the north.

During the voyage of the *Vega* from her winter quarters through Behring's Straits and farther south, Nordenskjöld searched for a tribe called Onkilon, said to be allied to the Eskimo, but without success. He found only reindeer-owning Tchuktches, and supposes that the name Onkilon, given by Wrangel to the old tribe inhabiting the coast and driven out by the Tchuktches, is probably related to the name Ankali, given by the reindeer-owning Tchuktches to the coast Tchuktches. Nordenskjöld states that English authors who refer Eskimo and Tchuktches to the same origin are mistaken. It was found that the inhabitants on the American side are pure Eskimo, with whom it was possible to carry on barter by means of the list of Eskimo words published in "Arctic Geography and Ethnology," London, 1875; but that the language spoken by the Tchuktches, of which Lieut. Nordquist collected about 1,000 words, is quite different, and probably allied to that of the Iranian races. On the other hand there is a complete correspondence between the household furniture of the Tchuktches and the Eskimo. It may be safely affirmed, he says, that these two neighbouring races have a greater number of identical articles in their tents than of common words in their languages.

The hills at Cape York on the American side were found to consist of crystalline schists without organic remains. Among the natives, who were Eskimo, there was a Tchuktch woman who said that Tchuktch tribes were settled on the American side between Point Barrow and Cape Prince of Wales. The Eskimo used, along with breechloaders, revolvers, and axes obtained from the Americans, bows and arrows, bone boat-hooks, and various stone implements. They were friendly and agreeable, and less given to brandy than the Tchuktches. There did not appear to be any chief among them. Complete equality prevailed, and the standing of the women did not appear to be inferior to that of the other sex. Among the stone implements were found arrow-heads and other articles of a species of nephrite so closely resembling the well-known nephrite from High Asia, that these implements were supposed to have actually come from that region.

A warm current, as in Europe, was found to flow along the north-western coast, and to create there a far milder climate than that which prevails on the Asiatic side. The limit of trees therefore lies a good way to the north of Behring's Straits, while the whole of the Tchuktch Peninsula appe rs to be devoid of trees. This is the case also with the land along the coast at Port Clarence, but a short distance inland there were bushes two feet high. Vegetation was generally luxuriant, and a great number of species were identical with, or nearly allied to, those of the Scandinavian north, among others the *Linnea*. Notwithstanding the luxuriance of the vegetation, the land invertebrates were much poorer in species than in the north of Norway. Thus only from ten to twenty kinds of beetles could be found, principally *Harpali* and *Staphylini*, and of land and fresh-water mollusca only seven or eight species. The avifauna was also rather scanty, and the dredgings in the harbour at Port Clarence, on account of the unfavourable nature of the bottom, yielded only a small number of animal and vegetable species.

The *Vega*, crossing to the Asiatic side, anchored in Konyam Bay on July 28. On the north shore of this Bay Dr. Kjellman added seventy species of flowering plants to the collection he had previously made. Here, too, were

found the first land mollusca on the Tchuktch Peninsula. Nordenskjöld considers it probable that on the southern part of this peninsula there was in former times a little inland ice. On July 31 the *Vega* was anchored at St. Lawrence Island. Drift ice was seen for the last time. The quantity of ice carried by the Polar current through Behring's Straits is very inconsiderable, and it has evidently been for the most part formed along the coast. Not a single iceberg was visible, the whole of the ice seen being level and rotten "year's ice." St. Lawrence Island is inhabited by Eskimo, who having frequent intercourse with the Tchuktches, have adopted some of their words. The prevailing rock is granite, weathering readily, and thus giving origin to a very fruitful soil. Vegetation was exceedingly luxuriant, and rich collections of land and marine animals, lichens, and algæ were made.

The *Vega* next anchored off Behring Island on August 14. This island belongs to Russia, but the American Alaska Company has acquired the right of hunting, and maintains a station where skins, principally those of the *Otaria ursina*, are purchased. Between 50,000 and 100,000 of these animals are killed yearly on this and the neighbouring Copper Island. They yield the brown "sealskin" so much in fashion in recent years. Behring's Island is supposed to have been visited first by Behring, who, after being shipwrecked, died there in 1741, survived, however, by many of his companions, among others, by the talented naturalist Steller, who described the natural history of the island in a masterpiece that has seldom been surpassed. Since Steller's time great changes have taken place. The *Canis lagopus* then occurred in incredible numbers. Now they are so uncommon that not one was seen, and those that remain are not dark blue, but white, the skins being of little value. On the neighbouring Copper Island dark blue foxes are still found in considerable abundance. In 1741-42 Stellar and his companions killed here about 700 sea-otters. This animal, famous for its precious fur, is now quite extinct on Behring's Island. Of the sea-lion (*Otaria stelleri*), formerly abundant, only single specimens are to be found along with the sea-bear (*Otaria ursina*) on the rocky shores of the island, and the great sea-cow, the most remarkable of all the mammals formerly belonging to Behring's Island, is now completely extinct. Steller's sea-cow (*Rhytina stelleri*) was of a brownish colour, covered with hair which grew on a hide resembling the bark on an old oak. Its length, according to Steller, was sometimes as much as thirty-five feet and its weight nearly 50,000 lb. The female yielded abundance of milk, which, along with the flesh, resembled, and were even, according to Stellar, superior to those of the cow. The sea-cow fed on the abundant algæ along the coast in great herds. According to Middendorf, the last sea-cow was killed in 1768. Nordenskjöld, however, found a "creole" of mixed Russian and Aleutian blood, whose father had come to the island in 1777, and remembered the killing of sea-cows while they fed on seaweed at low water for the first two or three years (1779 or 1780) after his arrival. Nordenskjöld also found two men who had seen, about twenty-five years ago, a large animal corresponding to Steller's sea-cow. He also obtained two complete skulls of the animal and a quantity of bones sufficient to fill twenty-one large boxes and barrels. The sea-bear (*Otaria ursina*) is the only large animal that exists on the island in about as large numbers as in Steller's time. It is "preserved" by the Alaska Company, only a limited number being killed yearly.

The vegetation on Behring's Island was found to be exceedingly luxuriant, and the sea in its neighbourhood one of the richest in algæ in the world. Forests of algæ, sixty to a hundred feet high, grew in favourable situations, rendering dredging exceedingly difficult. Some of the algæ are used by the natives as food.

The small streams swarmed with a number of different kinds of fish, among them a species of *Coregonus*, a little *Salmo fario*, a middle-sized salmon with nearly white flesh and a purple skin, and another of the same length, but very thick, and with a hump on its back. Other species of salmon with deep red flesh are found in the larger rivers. Leaving Behring's Island on August 19, the *Vega* reached Yokohama on September 2 in good order and with every man on board in excellent health. There had not been a trace of scurvy during the whole voyage.

GALILEO AND THE APPLICATION OF MATHEMATICS TO PHYSICS[1]

II.

IN dealing with the falling body I had to ask you to think what is the speed at any moment of a body which is changing its speed every moment, every half moment, every hundredth part of a moment or what we call continuously. It is easy to see that it has *some* speed at every point, and that the speed at every point is quite definite. I indicated a way in which we could fix this approximately, by taking the average speed over short intervals. A similar question is raised in considering the path of the projectile. Its direction changes from point to point. The bullet is shot towards the east, and, for the sake of picturing its path, I imagine the lines vertically upward to be called northwards, as on a vertical map. At first the particle starts off, let me say, in a direction N.N.E. When it has reached the top of its path it is going horizontally—due east—when it has got back to the level the Northing has been turned into Southing, and it is going S.S.E. In its upward motion it changes continuously from N.N.E. to E. At a certain position it is half a point more to the east and less to the north; further on, a point more; further on again, the Northing has disappeared. The path has curved away; it is curving away at every point of it. A particle moving at a uniform rate in a circle changes its direction; but at every point the amount of curvature or immediate bending away from the direction in which the particle moves at any moment is the same. In a small circle the curve bends away faster than in a larger one from the line which represents the direction of motion at any point, but in each separate circle the measure of bending must at every point be the same. How will it be in a different kind of curve, such as an ellipse, or the path of a projectile, a parabola? As the speed of falling changes from moment to moment continuously, the curvature changes from moment to moment.

In solving the problems of falling bodies and of projectiles, Galileo was essentially applying the principles of the Differential or Fluxional or Indivisible Calculus. If pure mathematics had attracted him as strongly as its application to physics, he would have thought these problems out, and would have founded the Fluxional Calculus, which is the glory of Newton and of Leibnitz. No doubt the world saw more in his great astronomical discoveries; in the telescope, which brought the moon thirty times nearer, and showed its mountains and the jagged edges of its gibbous side; in the discovery that Venus waxes and wanes with phases like the moon; in the four satellites of Jupiter, the famous Medicean stars, which showed the most restless activity of revolution round their central orb—an activity unprecedented in celestial bodies and discomposing to the Peripatetics, whose stately order of the heavens could not tolerate stars which behaved like sky rockets—of the curious double satellite of Saturn, which sometimes was even more bewildering, and went out altogether. It was the Ring, and Galileo gave what we now recognize as a very fair picture of it. No wonder that the man who first made the

[1] An Introductory Lecture, by William Jack, M.A., LL.D., F.R.S.E., Professor of Mathematics in the University of Glasgow, formerly Fellow of St. Peter's College, Cambridge. Continued from p. 43.